Determining the 3D orientation of High Velocity Clouds by Monte Carlo Modeling

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**MOTIVATION**

The overall purpose is to develop a method estimating the three-dimensional orientation of compact high velocity clouds (HVCs).

The main unknown is the inclination angle, i.e. the angle between the cloud trajectory and the line of sight. The goal is to compare the kinematic information contained in position-velocity plots of HVCs with model HVCs at known inclination angles. Here, we explore an algorithm matching mock HVCs at arbitrary angles with a template.

**BACKGROUND**

The Galactic halo contains a large population of neutral hydrogen clouds, named HVCs for the fact that their radial velocities do not match standard Galactic rotation patterns. HVCs are thought to play a role in providing the Galaxy with metallicity fuel for star formation and are contributing to the Galactic baryonic mass. Understanding their origin involves finding distances and trajectories. It is the latter we are addressing in this study.

Compact HVCs (CHVCs) often display a cold dense core and a warm diffuse tail, suggesting that they interact via hydrodynamical instabilities with the ambient Galactic halo gas. This interaction leads to differential drag, and thus to kinematic signatures in position-velocity plots, which then can be used to estimate the inclination angle of a CHVC.

**RESULTS**

Figure 3 summarizes the tests for an inclination angle of 34°. The algorithm finds the ‘true’ angle quickly. The test angles of the Metropolis-Hastings algorithm are varied in multiples of five. This would not be necessary for the current study, but we already explore the stability of the algorithm under this constraint, since future work will involve full 3D hydrodynamical simulations, which are – for resource reasons - not available at arbitrary inclination angles.

**METHOD**

The goal of this study is to compare hydrodynamical simulations of CHVCs with observations, and to derive the inclination angle. In this first step, we test an algorithm matching a position-velocity plot of a model CHVC at arbitrary inclination angle with a mock data set.

We construct the mock data set with a simple description using a density and velocity gradient along the long axis of the cloud, mimicking the observed head-tail structure (Fig. 1). From this mock HVC, we generate a position-velocity plot at a given angle via optically thin radiative transfer, to which a background and noise is added. This will be our “data set” (Fig. 2).

The mock HVC serves also as “template” for identifying the inclination angle. We achieve this via a Metropolis-Hastings algorithm, which attempts to minimize the squared difference between the template and the data set by varying the inclination angle of the template.

![Image](image-url)

**REFERENCES**

